THE EFFECT OF SOFT SHELL CLAMS ON MACROALGAL BLOOMS IN RESTORED SALT MARSHES OF COASTAL MASSACHUSETTS

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Background

Tidal restriction of salt marshes throughout the eastern US has resulted in eutrophication, displacement of native species, and harmful algal blooms *(2)*. Despite restoration of tidal flow to many of these marshes, algal blooms continue to be a serious problem in these systems *(4)*.

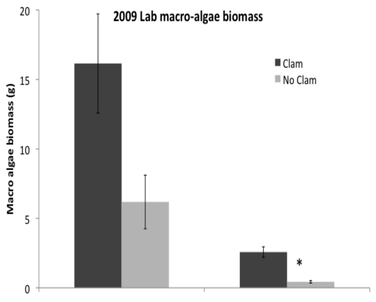
The restoration of tidal flow to East Harbor salt marsh, North Truro, Massachusetts, by Cape Cod National Seashore, has quickly resulted in successful recolonization by native salt marsh invertebrates; however, macroalgal blooms continue to be a serious problem at the site *(1)*. These blooms have caused periodic die-offs of reestablishing native fish and shellfish, and local residents have been concerned about the resulting odors.

Our recent studies strongly suggest that the successful recolonization of East Harbor by soft shell clams (*Mya arenaria*) may be facilitating macroalgal blooms by increasing water column clarity and increasing nutrient availability in the benthos and water.

East Harbor field study sites 2009, Cape Cod National Seashore, North Truro, MA.

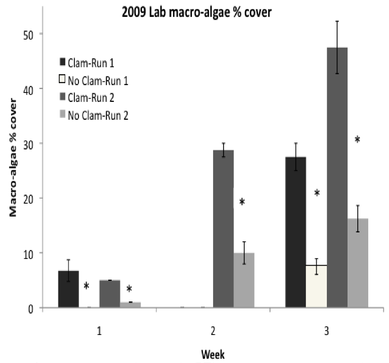
Data analysis

Laboratory results

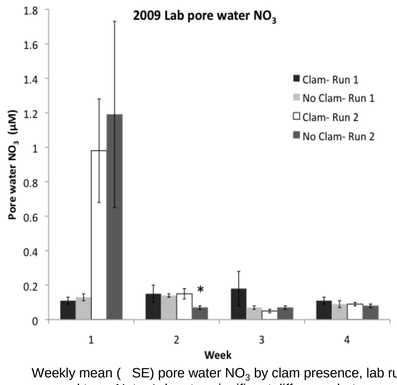


Lab run one and two algal biomass(g) by clam presence (SE) (non-parametric Wilcoxon rank sum).

Dried algal biomass collected from mesocosm, 2010 season. Photo credit: R. Thiet.

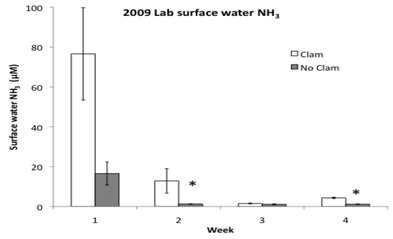


Lab algal percent cover (SE) by clam presence, lab study one and two. No data for run one week two, * denotes significant difference between treatments during each week at α≤ 0.05 (non-parametric Wilcoxon rank sum).

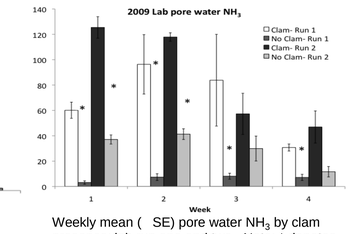


Weekly mean (SE) pore water NO_3 by clam presence, lab run one and two. Note: * denotes significant difference between treatments during each week at α≤ 0.05 (non-parametric Wilcoxon rank sum).

Laboratory results continued



Weekly mean (SE) surface water NH_3 by clam presence, lab run two. Note: * denotes significant difference between treatments during each week at α≤ 0.05 (non-parametric Wilcoxon ranksum).



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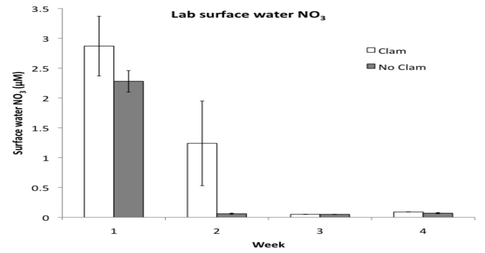
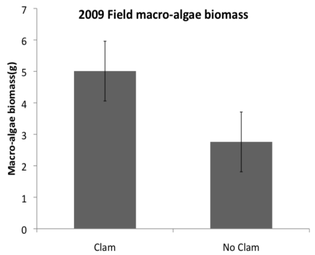
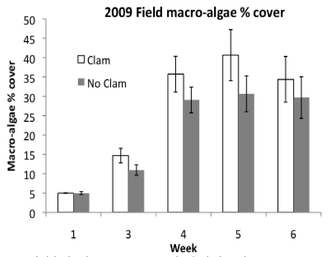


Weekly mean (SE) surface water NO_3 by clam presence, lab run two. Note: * denotes significant difference between treatments during each week at α≤ 0.05 (non-parametric Wilcoxon ranksum).

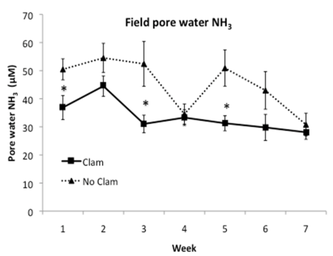
Field results



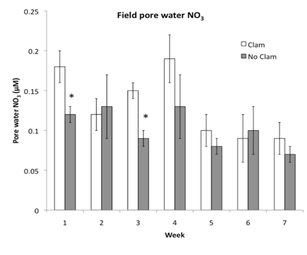
Field algal biomass(g) by clam presence(SE) (MANOVA and ANOVA).



Field algal percent cover(SE) by clam presence (MANOVA and ANOVA).



Field sediment pore water NH_3 weekly averages (SE) by clam presence Note: * denotes significant difference between treatments during each week at α≤ 0.05 (Parametric t-test).



Field sediment pore water NO_3 weekly averages (SE) by clam presence Note: * denotes significant difference between treatments during each week at α≤ 0.05 (Parametric t-test).

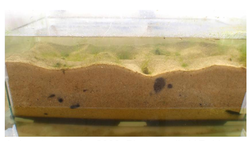
Experimental design

Laboratory Study

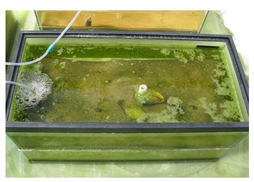
In 2009-2010 we established experimental laboratory mesocosms using 10-gallon aquaria filled with beach sand and salt water; we seeded half of the mesocosms with soft shell clams and left the rest as clam-free controls. Each year, we conducted two consecutive experimental runs, each lasting three to four weeks. In each tank, we took weekly measurements of algal percent cover, chlorophyll *a* levels, and water column and benthic pore water nitrate, ammonia, and phosphorous.

Field Study

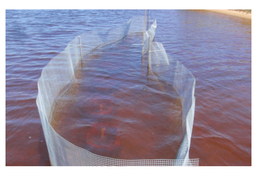
In 2009, we also conducted a field study at East Harbor, in which we established 32 sand-filled bucket mesocosms throughout the marsh. As in the lab study, we seeded half the mesocosms with clams and the rest were clam-free controls. We took weekly macroalgal percent cover and pore water nitrate, ammonia, and phosphorous measurements; total macroalgal biomass was calculated at the end of the study.



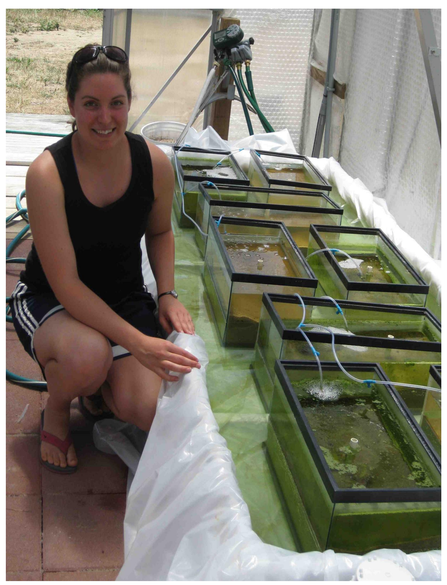
Laboratory study , 2009. Photo credit: V.Rubino.



Laboratory study mesocosm with clams, 2010. Photo credit: R. Clark.



Field study site, 2009. Photo credit: V. Rubino.



Greenhouse set up of cool water bath with mesocosms, 2010. Photo credit: R. Thiet.

Summary and future directions

Our algal biomass and percent cover results strongly suggest that soft shell clams are facilitating macroalgal blooms at this site. Surface and pore water NH3 and NO3 levels were higher in clam mesocosms in the lab study, suggesting that N additions by clams may be the mechanism for increased algal growth. In the field, NH3 pore water levels were lower and NO3 levels were higher in clam mesocosms.

We will expand the laboratory study in 2011 by adding periwinkles to a subset of our mesocosms to evaluate the effects of grazing on macroalgal growth. Recent studies suggest that the absence of periwinkles in the lagoon at East Harbor may be allowing algae to flourish *(3)*. If periwinkles were more abundant in the lagoon, they may be able to control macroalgal growth through grazing.

Acknowledgements

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References

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